

ACCEPTED/FILED

OCT - 8 2015

Before the
Federal Communications Commission
 Washington DC 20554

Federal Communications Commission
 Office of the Secretary

In the Matter of)

Aviat Networks, Request for Waiver of)
 Certain Antenna Requirements in the)
 71-76 and 81-86 GHz Bands)

No. _____

AMENDMENT TO REQUEST FOR WAIVER

On April 5, 2013, Aviat Networks, through its affiliate Aviat U.S., Inc., requested a partial waiver of Section 101.115 to permit smaller antennas in the 71-76 and 81-86 GHz bands.

A copy of that waiver request is attached.

The request included three elements:

1. a new suppression table that allows for Category A and B antennas, lower minimum gain (38 vs. 43 dBi), higher maximum beamwidth (2.2 vs. 1.2 degrees), and modified suppression criteria at various angles;
2. application of the co-polar discrimination requirement to the range of angles 2.5-5 degrees from the centerline, rather than 1.2-5 degrees as at present; and
3. relaxation of the required cross-polar discrimination from 25 dB to 21 dB.

The Fixed Wireless Communications Coalition (FWCC), of which Aviat Networks is an active member, had previously asked the Commission to amend its rules as to element (1), above,¹ and later expanded its request to include elements (2) and (3) as well.² Aviat Networks' April 5, 2013, waiver request seeks relief pending this rulemaking, which has not yet begun.

¹ Comments of the Fixed Wireless Communications Coalition in Response to the Commission's Notice of Inquiry in WT Docket No. 10-153 (filed Oct. 5, 2012).

² Letter from Mitchell Lazarus, Counsel, FWCC, to Marlene H. Dortch, Secretary, FCC in WT Docket No. 10-153 (filed April 4, 2013).

Like others in the industry, Aviat Networks is particularly interested in non-parabolic planar antennas, whose small size, thin profile, and light weight offer major advantages over traditional parabolics. The waiver request explained that planar antennas are aesthetically inconspicuous, can easily be integrated into existing macrocell sites, offer easy collocation even on crowded towers and rooftops, and greatly reduce tower costs. During the eleven months since Aviat Networks filed its request, the need for smaller, lighter, less obtrusive antennas has only become more urgent.

Aviat Networks' continuing antenna development work, however, has uncovered another unexpected impediment to planar antennas in the current rules. Planar antennas that satisfy the other conditions in the requested waiver cannot also comply with the magnitude of the required co-polar discrimination, namely, $G-28$ dB, where G is the antenna gain in dBi.³ The requirement is less demanding for lower-gain antennas, and in fact our prototypes at 38 dBi can pass; although just barely. But our 43 dBi planar antennas cannot. The problem is not amenable to better design or construction, but rather appears to be integral to the physics of wave activity that governs antenna performance.

For these reasons, Aviat Networks must add a fourth element to its waiver request:

4. reduction of the required magnitude of co-polar discrimination from $G-28$ dB to $G-33$ dB, where G is the antenna gain in dBi.

By *ex parte* letter, the FWCC is today updating its rulemaking request to include this element as well.

The proposed change sidesteps the question whether "G" in the rule refers to nominal or measured antenna gain. The measured gain increases with frequency, which could make the co-polar discrimination requirement more stringent at higher frequencies. Where compliance is a

³ 47 C.F.R. § 101.115(b) (note 15).

close call, an antenna might meet the standard at some frequencies but not at others. The requested relaxation moots this question, as it makes possible the design of antennas capable of complying at all relevant frequencies no matter how the gain is specified.

This change will not diminish the public interest in the waiver. To the contrary, inasmuch as the present rule permits parabolics while disqualifying high-gain planar antennas, the waiver will directly support the Commission's policy in favor of technology-neutral regulation.

We do not see a downside. The original proponent for the co-polar discrimination requirement referred specifically to the "need to control interference to a narrow, spatial pipe,"⁴ apparently related to multiple links that share the same geographic path, *e.g.*, between the same two rooftops. The Commission, in adopting the requirement, added no further explanation.⁵ Whatever the merits of the requirement as to the applications for which it was intended, it has no relevance to the small-antenna, short-range applications that will benefit from the waiver. We note, additionally, that all of the fixed service bands below 71 GHz function well without *any* co-polar discrimination requirement.

⁴ Petition for Reconsideration of Wireless Communications Association International in WT Docket No. 02-146 at 16-18 (filed Feb. 23, 2004).

⁵ *Allocations and Service Rules for the 71-76 GHz, 81-86 GHz and 92-95 GHz Bands*, Memorandum Opinion and Order, 20 FCC Rcd 4889 at ¶ 34 n.103 (2005).

CONCLUSION

We ask the Commission to process the April 5, 2013, waiver request as quickly as possible, subject to the amendment above.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Mitchell Lazarus". The signature is written in a cursive, flowing style.

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March 24, 2014

ATTACHMENT

Before the
Federal Communications Commission
Washington DC 20554

In the Matter of

Aviat Networks, Request for Waiver of
Certain Antenna Requirements in the
71-76 and 81-86 GHz Bands

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)
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No. _____

REQUEST FOR WAIVER

April 5, 2013

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TABLE OF CONTENTS

A.	Summary	1
B.	Procedural History	2
C.	Developments Necessitating this Request	3
1.	Network developments	4
2.	Antenna developments; reduced costs	7
3.	Implications for antenna standards	9
D.	Specific Waiver Requests	10
E.	Protection of Other Users.....	11
F.	Public Interest	12
G.	Waiver Conditions	13
	CONCLUSION.....	14

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71-76 and 81-86 GHz Bands)	

REQUEST FOR WAIVER

Pursuant to Section 1.3 of the Commission's rules, Aviat Networks, through its affiliate Aviat U.S., Inc., requests a partial waiver of Section 101.115, as described below.

Aviat Networks is a leading global provider of microwave networking solutions. The company equips public and private operators with communications networks capable of handling the exploding growth of IP-centric, multi-gigabit data services. Its microwave backhaul products have particularly proven themselves in 4G/LTE network deployments. The company has about one million systems installed worldwide.

Aviat Networks' history traces back to 1958, near the dawn of the microwave age, resulting from a 2010 merger between Digital Microwave Corporation (later Stratex Networks), formed in 1984, and Farinon/Harris MCD (Microwave Communications Division), established in 1958. The company and its predecessors have always been headquartered in the United States, and still builds Buy American compliant products in Texas. Aviat Networks employs 1,017 people in 38 countries, including 504 in the United States.

A. SUMMARY

Technical rules for the 71-76/81-86 GHz bands, adopted ten years ago, are well suited to high-capacity links among towers and rooftops. During that decade, however, only about 5,500 links have been registered nationwide for these bands, plus 92-95 GHz. The same time period

has seen customers' needs evolve. Today there is a growing demand for systems that cover shorter distances at lower capacity and which operate closer to street level, and thus call for antennas that are smaller, thinner, lighter, and aesthetically less objectionable than those considered in the original rulemaking.

The Fixed Wireless Communications Coalition (FWCC), of which Aviat Networks is an active member, has asked the Commission to amend certain provisions of Section 101.115 to permit smaller antennas at 71-76/81-86 GHz. But the rulemaking will probably take years, while the matter is urgent. Aviat Network accordingly requests a waiver of the same provisions, so as to permit the marketing and installation of smaller antennas on a provisional basis pending the rulemaking. We show below that the waiver will not impair spectrum efficiency, and we propose conditions to ensure that other users of the band, including the Radio Astronomy Service, remain free of interference.

Because the waiver will meet the needs of providers and improve the use of the band with no adverse effects, we submit it is in the public interest and we ask the Commission to grant the waiver expeditiously.

B. PROCEDURAL HISTORY

The FWCC requested a rule change to relax the antenna standards in the 71-76/81-86 GHz bands.¹ Antennas in these bands are subject to additional provisions, including this one:

At angles between 1.2 and 5 degrees from the centerline of the main beam, co-polar discrimination must be $G-28$, where G is the antenna gain in dBi; and at angles of less than 5 degrees from the centerline of main beam, cross-polar discrimination must be at least 25 dB.²

¹ Comments of the Fixed Wireless Communications Coalition in Response to the Commission's Notice of Inquiry in WT Docket No. 10-153 (filed Oct. 5, 2012).

² 47 C.F.R. § 101.113(a) (table) n.15.

The FWCC subsequently filed an *ex parte* request that the Commission apply the co-polar discrimination (CPD) requirement to the range of angles 2.5-5 degrees from the centerline, rather than the 1.2-5 degrees presently required, and reduce the 25 dB cross-polarization discrimination (XPD) requirement to 21 dB.³

Aviat Networks believes that these FWCC initiatives are in the public interest. Even assuming the Commission ultimately agrees, however, the delays occasioned by the Administrative Procedure Act and the press of the Commission's other business are likely to postpone a rule amendment for a period of years.⁴ Aviat Networks submits that the benefits of the change, and the absence of harm to any spectrum user, justify the Commission's granting a waiver pending the rulemaking.

C. DEVELOPMENTS NECESSITATING THIS REQUEST

Predicting future developments in technology is notoriously difficult. Even harder is predicting the ultimate uses of an emerging technology. Some people in the 1970s saw the coming of pocket-sized wireless phones, but few then foresaw how wireless phones would eventually exploit broadband connectivity for the sophisticated apps we now use every day.

Something similar is happening with the 71-76/81-86 GHz bands. The Commission expected these bands would substitute for fiber-optic cable, offering extremely high capacity between points that generate or consume large amounts of data. Certainly this is the kind of

³ Letter from Mitchell Lazarus, Counsel, FWCC to Marlene H. Dortch, Secretary, FCC in WT Docket No. 10-153 (filed April 4, 2013).

⁴ For example: FiberTower, Inc., an FWCC member, filed a Petition for Rulemaking seeking relaxed antenna standards in the 11 GHz band on July 14, 2004. It took the Commission more than three years to adopt rules. *Antenna Requirements for the 10.7-11.7 GHz Band*, Report and Order, 22 FCC Rcd 17153 (2007). This time scale is on the speedy side for recent Part 101 actions.

application described by the original petitioner for the 71-76/81-86 GHz rules,⁵ which called the technology “virtual fiber.”⁶ Ten years ago, the relatively high cost of equipment for these bands limited applications to those having very high traffic demands, typically among rooftops and towers.

Since then, however, as costs have dropped, the 71-76/81-86 GHz bands have become more attractive for applications that carry less data over shorter distances, and require antennas closer to the ground. The increasing density of sites that serve public mobile networks is changing the nature of “backhaul” connections—*i.e.*, the connections between network facilities and cell towers. Backhaul distances are declining from kilometers to a few hundred meters.⁷ Small cell deployment will accelerate this trend.

1. Network developments

The firm Mobile Experts predicts that small cell backhaul alone will grow from near zero today to over a million links by 2017 (Figure 1). Wireless will be the predominant technology used, making up between 60 and 70 percent of small cell backhaul deployments through 2017 (Figure 2).

⁵ Petition for Rulemaking of Loea Communications Corporation in RM-10288 (filed Sept. 10, 2001).

⁶ Comments of Loea Communications Corporation in WT Docket No. 02-146 (filed December 18, 2002).

⁷ “In general adding new real estate is time consuming and increasingly prohibitive. With median intersite distances dropping from 5km to 2km and recently to less than 200m in dense urban areas, the operator has less choice in selecting affordable property.” 4G Americas, “MIMO and Smart Antennas for Mobile Broadband Systems,” at 4 (October 2012), *available at* <http://www.4gamericas.org/documents/MIMO%20and%20Smart%20Antennas%20for%20Mobile%20Broadband%20Systems%20Oct%202012x.pdf>.

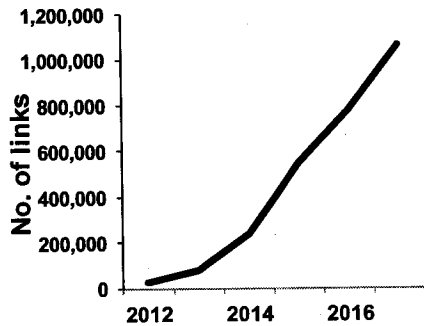


Figure 1
Projected Backhaul Links for
Outdoor Small Cells

Source: Mobile Experts

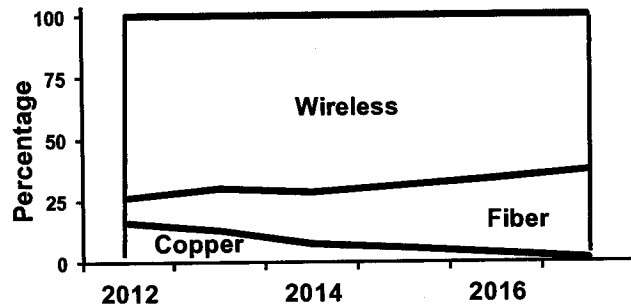


Figure 2
Percentages of Outdoor Small
Cells Backhauled by Various
Technologies

Source: Mobile Experts

These developments will bring mobile network base stations and associated infrastructure, including backhaul, into locations that are physically closer to the consumer. Conventional macrocells are typically deployed with cell radii of 1 km or so. The radii of small cells will be much smaller, in the 100 m to 400 m range, and sometimes as short as 70 m. Wireless solutions in the 71-76/81-86 GHz bands are ideal for these distances.

For small cells to be practical, both the base station and the backhaul elements must shrink dramatically in size, to the point there they can integrate into the urban environment near street level. Additional size constraints come from municipal and building regulations that variously limit the dimensions of wall-mounted, rooftop, and pole-mounted antennas. Although 1- and 2-foot parabolic antennas serve well for macrocell infrastructure, their size, weight, cost, and time needed to deploy are all too large to support ubiquitous small cell deployment. Cost is particularly critical, as the antennas often represent the biggest overhead for a site.

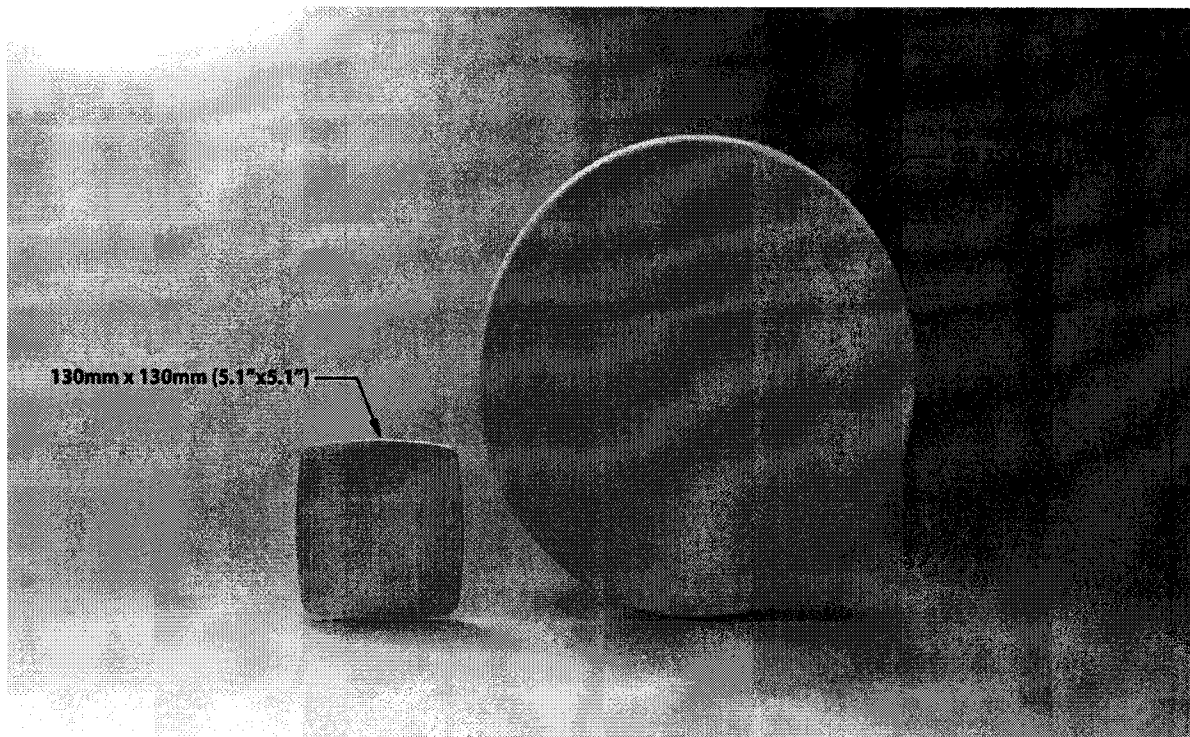


Figure 3
**The Changing Face of mm Wave
Antenna Technology**

The demands of small cell deployment are driving providers toward higher frequencies, which offer high data capacity and relatively small antennas. The same demands are also driving innovations in antenna design. The Commission's rules, however, have unintentionally become a major (and unnecessary) hindrance to innovation. The current antenna standards hamper an operator's ability to use the 71-76/81-86 GHz bands for small cell backhaul, among other applications. Under these standards, moreover, the bands are severely underutilized. Since 2005, there have been only about 5500 registered links at 71-76/81-86/92-95 GHz, nationwide.⁸ Unless promptly waived, the rules will threaten widespread use of these bands, hinder small cell

⁸ Source: Comsearch.

deployment, and dampen the broad economic momentum normally associated with a new network build-out.

2. *Antenna developments; reduced costs*

The ongoing quest for smaller, lighter, less expensive antennas has resulted in metalized plastic planar antennas ideal for use at 71-76/81-86 GHz. Figure 3 compares an antenna that would qualify under the requested waiver to a compliant antenna. Figure 4 shows a radio unit with integral antenna that would qualify under the requested waiver. The advantages of the waived antenna in size and aesthetic benefit are self-evident.

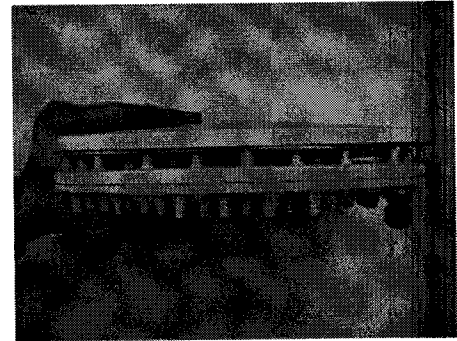


Figure 4
Product Including Waivered
Antenna (to scale)

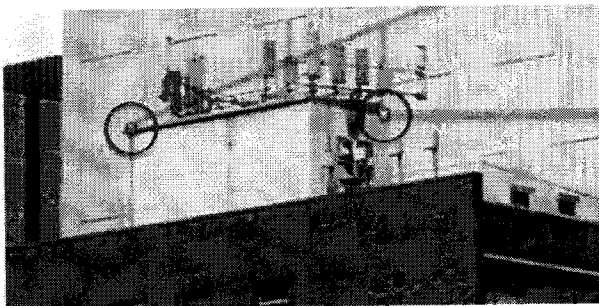


Figure 5
Waivered Antennas in
Typical Installation

In Figure 5 are two of the waived antennas in a typical urban rooftop installation. No re-engineering of the site is required. This is important, as it allows the rapid installation of backhaul for new cells. Moreover, the antennas are aesthetically inconspicuous. The small size and thin

profile reduces visual clutter, making these antennas far preferable for sites near street level, and potentially rendering them usable even in inner-city preservation zones.

These antennas have other advantages as well:

- scalable data capacity from 400 Mbps to 1 Gbps;
- easily integrated into existing macrocell sites;

- reduced packaging and shipping costs, warehouse requirements, and waste disposal;
- additional antennas easily collocated;
- spectrum congestion relief for more “traditional” urban microwave at 18-38 GHz; and
- antenna congestion relief on crowded towers and rooftops.

Waivered antennas will also provide a very significant reduction in tower lease costs, for applications that use towers. Tables 1-3 compare compliant (parabolic) and waived (planar) antennas as to size, weight, tower occupancy, and tower costs. According to the consulting firm Steel in the Air, Inc., the factors affecting tower leasing fees include the size of the lease area required, weight and size of antennas, and availability of space.⁹ Small planar antennas decrease the costs associated with each of these.

	Dimensions				
	H (in)	W (in)	D (in)	Volume (cubic ft)	Weight (lbs)
Parabolic 1 ft antenna	13.8	13.8	7.9	0.86	8.8
Planar antenna	5.1	5.1	0.6	0.01	1.1

Table 1 – Parabolic 1 ft. vs. Small Planar Antennas

Infrastructure gains	
Volume reduction	98.96 %
Weight reduction	87.53 %

Table 2 – Space/weight gains with small planar antenna

Antenna	Vertical height (inches)	Lease cost (per month)	Cost reduction
Parabolic 1 ft	12	\$100.00	
Planar	5.1	\$42.50	57.7%

Table 3 – Potential Operator TCO Benefit (typical vertical height-based fees)

⁹ Source: <http://www.steelintheair.com/Tower-Collocation-Leases.html>

3. *Implications for antenna standards*

The Commission has said its rules do not mandate the use of parabolic antennas.¹⁰ In fact, however, the rules were developed during a period when parabolic antennas were the only practical way to achieve high directionality. The Commission acknowledged the introduction of planar array antennas by allowing manufacturers to meet a maximum 3 dB bandwidth requirement as an alternative to the minimum gain requirement.¹¹ But the remainder of the standards, including the envelope pattern and the CPD and XPD requirements, continue to favor parabolics.

Achievement of the marked reduction in antenna dimensions shown in Figure 3 and Table 1, and the advantages that follow from smaller size, weight, and cost, will require minor departures from the Commission's antenna standards. Antenna manufacturers worldwide, including Aviat Networks and its partners, have made great advances in squeezing more performance out of ever-smaller antennas. But the physics of diffraction remains a stubborn constraint. The industry has reached the point where the special case of optimal backhaul installations for short links at 71-76/81-86 GHz requires a small degree of relief from the current standards.

The market is developing rapidly, as shown in Figure 1. In order to meet demand and foster the continuing growth of mobile broadband, the industry needs early relief from the existing standards.

¹⁰ *Amendment of Part 101 of the Commission's Rules to Facilitate the Use of Microwave for Wireless Backhaul and Other Uses*, Second Report and Order, Second Further Notice of Proposed Rulemaking, Second Notice of Inquiry, Order on Reconsideration, and Memorandum Opinion and Order, 27 FCC Rcd 9735 at ¶ 79 (2012).

¹¹ 47 C.F.R. § 101.115(b)(1). *See Amendment of Parts 74, 78, and 101 of the Commission's Rules to Adopt More Flexible Standards for Directional Microwave Antennas*, Report and Order, 12 FCC Rcd 1016 at ¶ 4 (1997) (adopting rule change to accommodate planar array antennas).

D. SPECIFIC WAIVER REQUESTS

In view of the foregoing, Aviat Networks requests a waiver having these three elements:

- (1) the option of compliance with the antenna standards shown in Table 4;
- (2) application of the co-polar discrimination requirement to a range of angles 2.5-5 degrees from the centerline; and
- (3) reduction of the required cross-polar discrimination from 25 dB to 21 dB.¹²

Frequency (MHz)	Category	Maximum beamwidth to 3 dB points (included angle in degrees)	Minimum antenna gain (dbi)	Minimum radiation suppression to angle in degrees from centerline of main beam in decibels						
				5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
71,000 to 76,000 (co-polar)	A	2.2	38	22	28	32	35	37	55	55
81,000 to 86,000 (co-polar)	A	2.2	38	22	28	32	35	37	55	55
71,000 to 76,000 (cross-polar)	A	2.2	38	35	35	40	42	47	55	55
81,000 to 86,000 (cross-polar)	A	2.2	38	35	35	40	42	47	55	55
71,000 to 76,000 (co-polar)	B	2.2	38	13	20	28	31	32	48	48
81,000 to 86,000 (co-polar)	B	2.2	38	13	20	28	31	32	48	48
71,000 to 76,000 (cross-polar)	B	2.2	38	33	33	33	38	40	48	48
81,000 to 86,000 (cross-polar)	B	2.2	38	33	33	33	38	40	48	48

Table 4 – Proposed Antenna Standards under Waiver

¹² Compare with 47 C.F.R. § 101.115(b)(2) (table) note 15.

Waivered antennas will have to comply with all other provisions, including the requirement that antenna gain below 50 dBi be accompanied by a reduction in maximum EIRP, in the ratio of 2 dB of power cut per 1 dB of antenna gain below 50 dBi.¹³ The proposed minimum antenna gain of 38 dBi would reduce the maximum power by 24 dB. In practice, though, because these antennas are intended specifically for short links, the actual power used in the large majority of cases will be far below the maximum.

E. PROTECTION OF OTHER USERS

Although other allocations are listed in the table,¹⁴ the services actually needing protection under the waiver will be other Fixed Service licensees at 71-76/81-86 GHz and the radio astronomy service (RAS) at 81-86 GHz.¹⁵

Waivered operation will rely on the same link-by-link frequency coordination system and database that are currently in use for compliant antennas. Incumbent users will thus be fully protected. The blockage of proposed links due to predicted interference from a waived antenna, where a compliant antenna would not block the applicant, should be extremely rare. The relatively low power emitted from waived antennas, and the high antenna performance required even under the waiver,¹⁶ should largely eliminate predicted interference into proposed new links as a consequence of the waiver.

¹³ *Id.*

¹⁴ *See generally* 47 C.F.R. § 2.106.

¹⁵ *See generally* *Allocations and Service Rules for the 71-76 GHz, 81-86 GHz and 92-95 GHz Bands*, Report and Order, 18 FCC Rcd 23318 at ¶¶ 6-24 (2003).

¹⁶ The minimum antenna gain we propose under the waiver, 38 dBi, is greater than or equal to the minimum antenna gain in every other band that for which a minimum is specified. *See* 47 C.F.R. § 101.115(b)(2) (table).

Similarly, application of the CPD requirement over a narrower range of angles and a slight reduction in the XPD requirement from 25 dB to 21 dB will not impede frequency coordination. No other fixed service band has either CPD or XPD requirements. The original rules for 71-76/81-86 GHz likewise had no such requirement. The Commission added them on reconsideration, at the request of Wireless Communications Association International (WCAI), with no explanation other than mention of WCAI's reconsideration petition.¹⁷ That petition, while terse, appears to seek the requirements as an aid in frequency coordinating multiple links that share the same geographic path, *e.g.*, between the same two rooftops.¹⁸ The applications best suited to waived antennas, however, will not entail shared high-capacity shared paths, and hence will not be adversely affected by adjustment of the CPD angle range or a small reduction in the XPD requirement.

RAS protection requirements will remain unchanged under the waiver. That is, the frequency coordination process will ensure that waived antennas provide no less protection to any RAS site than do Section 101.115-compliant antennas.

F. PUBLIC INTEREST

A grant of the requested waiver will facilitate the provision of wireless service to the public at lower cost, while reducing visual clutter and limiting the aesthetic offense of large antennas. The waiver will also stimulate activity in the underused 71-76/81-86 GHz bands while taking pressure off other fixed service frequencies used for urban applications, particularly 18

¹⁷ *Allocations and Service Rules for the 71-76 GHz, 81-86 GHz and 92-95 GHz Bands*, Memorandum Opinion and Order, 20 FCC Rcd 4889 at ¶ 34 n.103 (2005).

¹⁸ *See* Petition for Reconsideration of Wireless Communications Association International in WT Docket No. 02-146 at 16-18 (filed Feb. 23, 2004) (addressing the "need to control interference to a narrow, spatial pipe").

and 23 GHz. The waiver will achieve these advantages with no incremental risk of interference to other users.

Moreover, with the waiver in place, the same antenna will meet both Commission and ETSI requirements.¹⁹ This will give U.S. licensees inexpensive access to antennas mass-produced for the European market, and will simultaneously benefit U.S. manufacturers by enabling them to produce the same equipment for the U.S. and European markets.

G. WAIVER CONDITIONS

Aviat Networks proposes the following conditions on the waiver:

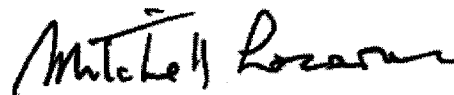
1. Licensees using waived antennas must comply with all Commission rules not expressly waived, including but not limited to the requirements relating to power/antenna gain trade-off, frequency coordination, and protection of RAS sites.
2. If an RAS operator reasonably suspects a waived 81-86 GHz antenna of causing harmful interference, the licensee will cooperate with the RAS operator in investigating and resolving the interference.
3. The waiver is subject to the outcome of the ongoing rulemaking in WT Docket No. 10-153 and any other rulemaking proceeding affecting 71-76/81-86 GHz antenna standards. In the event the Commission ultimately rules against relaxation of the standards for these antennas, the waiver will expire as of the effective date of that ruling (or after 30 days, if the ruling takes effect in a shorter time). Aviat Networks will not manufacture, import, or install a noncompliant antenna after the waiver expires.

¹⁹ The ETSI rules do not have CPD or XD requirements.

CONCLUSION

An early grant of the requested waiver will reduce costs, further broadband deployment, and benefit U.S. providers and manufacturers, with no adverse effect on any party. We urge the Commission to grant the waiver promptly.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Mitchell Lazarus". The signature is fluid and cursive, with the first name "Mitchell" written in a larger, more prominent script than the last name "Lazarus".

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Counsel for Aviat U.S., Inc.

April 5, 2013

TECHNICAL CERTIFICATION

I am a technically qualified person who reviewed the foregoing Request for Waiver. I certify that the technical statements therein are correct to the best of my knowledge.

IC Marshall

Ian Marshall
Regulatory Manager
Aviat Networks

5-APR-13
(date)

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